PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1957-58

TANGANYIKA TERRITORY
LAKE PROVINCE

PUBLISHED BY
THE EMPIRE COTTON GROWING CORPORATION,
12 CHANTREY HOUSE, ECCLESTON STREET,
LONDON, S.W.1.

1959

COMMONWEALTH MYCOLOGICAL INSTITUTE
21 SEP 1959

E.C.G.C. STAFF LIST.

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TANGANYIKA TERRITORY
LAKE PROVINCE
PROGRESS REPORT FOR THE SEASON 1957-58

COTTON SEASON.

Planting: Ukiriguru, late November, 1957, to mid January, 1958.
Picking: Ukiriguru, mid April, 1958, to mid August, 1958.
Legal uprooting date: 15th September, 1958.
Rainfall for the period 1st October, 1957, to the end of June, 1958:
Ukiriguru: 30·96 inches.

INTRODUCTION.

BY

J. E. PEAT.

Ukiriguru Research Centre.

Visitors.—Amongst the many visitors to Ukiriguru in 1958 were the new Governor, His Excellency Sir Richard Turnbull, K.C.M.G., and Lady Turnbull; Mr. A. E. Trotman, C.M.G., Minister for Natural Resources; the retiring Director of Agriculture, Mr J. R. P. Soper, C.B.E; the new Director of Agriculture, Mr. A. P. S. Forbes, and Mrs. Forbes; Chief Humbi Ziota, M.L.C., M.B.E., Assistant Minister for Natural Resources; Mr. Amir Karimjee, M.L.C., Assistant Minister (Commerce and Industry); on a number of occasions the Provincial Commissioner, Lake Province, Mr. S. A. Walden, C.M.G.; Mr. Arthur Gaitskell, C.M.G., for F.A.O.; Mr. Julius Nyerere, M.L.C., Chairman of the Tanganyika Elected Members Organisation; other members of the Legislative Council; Dr. G. M. Wickens, Senior Officer Designate of the E.C.G.C. in Tanganyika; and Mr. and Mrs. D. F. Ruston, E.C.G.C.

Staff.—Mr. and Mrs. M. H. Arnold were on leave from 25th May 1958 to 9th September 1958. Mr. and Mrs. K. J. Brown were on leave from 7th October 1957 to 10th March 1958. Mr R. A. Brown was on leave from 28th July 1958, and on his return to Tanganyika was posted to Malya. Mr. W. J. H. Le Bechee was posted to Ukiriguru on 26th June 1958. Mr. D. K. Lwehabura was transferred to Dodoma on 16th January 1958, and Mr. J. B. Machunda joined the staff on 1st January 1958.

There was a Regional Research Committee conference in Tabora from 16th to 18th September 1958 which was attended by three

members of the Ukiriguru staff including the writer, who also attended the meetings of the Specialist Committee on Agricultural Botany at Njoro, Kenya, from 23rd to 25th September 1958 and the Namulonge Advisory Board meetings from 8th to 10th December 1958.

Rainfall.—It was the third season running with a good rainfall distribution. The rainfall for the period from the beginning of October until the end of June—which covers the cotton growing season—was 30·96 inches. There was some anxiety—amongst cultivators who had delayed their cotton planting—caused by a dry spell of two weeks in January 1958. There was again a dry period from mid February until the end of the first week in March; but such dry spells around that time are a feature of the Lake Province climate. The total March rainfall was 6·37 inches, as shown below.

RAINFALL.

October, 1957, to June, 1958.

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	
0·24	1·22	6·67	3·60	2·04	6·37	5·24	5·12	0·46	= 30·96 inches.

Lake Province Cotton.

For the fifth consecutive season there has been record Lake Province cotton production—more than 152,000 bales, over 1,000 bales greater than in the 1956-57 season, then the record. The Province was planted to Uk51, apart from the Lyoma area of Bukumbi (Mwanza District) where Uk55 was multiplied. 52½ tons of Uk55 seed resulted from this multiplication, from the 3¾ tons of seed supplied from Ukiriguru. (4 tons of Uk58 are being multiplied in 1958-59 in the same Lyoma area.) It is reported that over 400,000 acres were planted in 1957-58, by nearly a quarter of a million growers, and that the yield averaged about 460 lb. seed cotton per acre. 83% of the crop was bought by the Co-operative Societies. The guaranteed price of Grade A (Safi) was 54 cents per lb. and for the second Grade (Fifi) 20 cents.

This is the last Progress Report from the Lake Province with which the writer will be associated. It might be well in the circumstances to review very briefly some of the agricultural factors that have influenced the development of the Lake Province cotton crop, more particularly the part that Ukiriguru has played, and the influences that Ukiriguru agronomic work could have on the future stability of production.

A great advance has resulted from the succession of seed issues, the effects of which can be followed in Figures 1 and 2. From Tables 8 and 9 in the cotton breeding section the improvements still to be derived from later seed issues are illustrated. As is mentioned in the body of the report it is highly probable that the improvements effected by the seed issues have proved in fact greater in the field than is claimed for them from small plot statistical comparisons.

A second advance has been from seed dressing against *Xanthomonas malvacearum,* again most probably, because of bacterial spread, more effective in the field than is shown from small plot work.

There is a mass of evidence from work at Ukiriguru on which farming improvements could be based—the great value of manuring with cattle manure, and the lasting profit from such applications, the value of fertilizer use, the value of land resting, the value of tie-ridging, the value of ridging and tying compared with flat cultivation where flat cultivation is practised in the south of the Province, and the great value of timely planting and timely weeding. Were reasonable use made of this experience a doubling of the present level of Lake Province cotton production would be possible.

On the reverse side of the picture is the fact that with rare exceptions the people are apathetic to proper land use, and at the present time politically resentful of guidance. The fertility in the richer, newer areas is declining.

The acreage planted may increase from year to year (it is reported that in the 1958-59 season about 20% more seed has been taken by the cultivators than in the previous season); there will be good years and bad years; but it is the view of the writer that a decline in cotton production is more likely than any steady increase, unless the people can be persuaded to farm, instead of merely planting acreages of cotton, in this Province naturally favourable for the growing of cotton as the main cash crop.

General Account of the Work for the Season.

Husbandry.

BY

J. E. PEAT and K. J. BROWN.

Time of Planting.

The time of planting trial had superimposed upon it comparisons of cotton strains with different lengths of maturity, Table 1. These gave comparisons of considerable interest. The first three strains are from the original Ukiriguru selection programme. The remaining three strains are segregates from the Albar 51 hybridising programme, but with different lengths of maturity.

Though the November yields were higher than the December yields, in general December is probably the wisest month for planting, with land preparation in November, since with November planting too much cotton opens at the end of April/early May, when the rains are still heavy. This was particularly so with the very early maturing

M12/15/385. This strain looked spectacular at the time of the earlier pickings, but was caught up and surpassed in the later pickings by the later maturing strains. It was thought, possibly, that an earlier cropping strain planted late might give better yields than the standard strains planted late. There are anomalies in the results for M12/15/385 comparing mid January and mid February plantings. This work is being continued.

In observation plots the general yield again favoured the November-December plantings with a drop in yield to around 70% for January planting, and a drop to around 40% for February planting.

TABLE 1.

TIME OF PLANTING EXPERIMENT.

Ukiriguru—Hill Sand—Trial (43).

Started 1955-56.

11 replications of 4 times of planting with split plots of 1/290·4 acres giving 6 variety treatments.

5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole.

Mean yields: seed cotton lb./acre.

Planting date	15th Nov.	15th Dec.	15th Jan.	15th Feb.
Uk55	947	904	728	564
1/667	962	856	769	596
5/266	1020	945	785	601
M12/15/385	729	684	487	734
67/04/42	848	711	640	597
E21/15/503	960	825	693	584
Mean	911	823	683	612

S.E. (L.S.D. 5%) of mean dates of planting ±35 (102)
S.E. (L.S.D. 5%) in same column ±37 (101)

In observation plots the setback to the crop from delayed early weeding was very striking—a 40% drop in yield. For cotton planted on the flat, where early weed growth was more serious than with ridged cotton, the drop in yield compared with tie-ridged cotton was of the order of 45%, with cotton ridged but not tied inferior to the tie-ridged cotton. The soil moisture aspects were followed up by the Soil Science section.

Land Resting.

The long term land resting trials have been discontinued. Trials (36), and (41) were continued, Trial (36) carrying the third indicator crop after the one season treatments, and Trial (41) the second indicator crop after the one season treatments. In Trial (36) there was a suggestion that there was still residual profit resulting from the one season tumbledown rest, especially where phosphate had been added to the first cotton indicator crop. In Trial (41), though the differences were not significant, there was still a suggestion of a response from the one season tumbledown rest.

Control Yields.

A feature of the season has been the comparatively high level of control yields. In the two trials mentioned in the previous paragraph the mean control yields averaged over 650 lb. seed cotton per acre. In the classical Trial (8) the mean control yield was 660 lb. seed cotton per acre; no treatment had been applied to the control plots for more than 14 years. The mean control yields in Trials (9), (26), and (44), are shown in the appropriate Tables. The cotton plants growing in the control plots looked on the whole small and somewhat scruffy, and in some plots suffered from *Alternaria,* a secondary poverty disease. The end yields are certainly better than had been expected. They illustrate what can be achieved even with exhausted soil, given timely planting and weeding, reasonable spacing, and good seed stocks. The agronomic trials were used for bulking up potential material for the Uk58 seed issue.

The relatively good yields from the impoverished controls in this past season do not vitiate the general argument that if the Lake Province of Tanganyika is to maintain productivity sound farming methods must prevail. Some of the newer and richer cotton areas are decreasing in fertility.

TABLE 2.

NPD EXPERIMENT.

Ukiriguru—Hill Sand—Trial (9).

Started NPK (1947-48).

NPD (1950-51). Re-applied 1956-57, 6 tons compost, 75 lb. and 150 lb. basic slag and 90 lb. urea/acre.

Main plots split to give 2 × 3 factorial, testing all combinations of:—
(Main plots) n_0, n, 0, 90 lb. urea/acre.
(Sub plots) d_0, d, 0, 6 tons compost/acre.
p_0, p_1, p_2, 0, 75, 150 lb. basic slag/acre.

6 replications of 12 plots each 1/69·7 acres. Compost and phosphate re-applied November 1956. Nitrogen applied 25th February 1958.

Cotton planted 5th December 1957.

Second indicator crops of the fourth cycle.

Mean yields: seed cotton lb./acre.

	(i)	d	n	nd	Mean
(i)	926	1580	1072	1654	1308
p_1	1210	1811	1253	1748	1505
p_2	1189	1880	1397	1864	1582
Mean	1108	1757	1241	1755	

S.E. (L.S.D. 5%) in same half of table	±86 (245)
S.E. (L.S.D. 5%) in different halves	±94 (291)
S.E. (L.S.D. 5%) of means for phosphate	±43 (122)
S.E. (L.S.D. 5%) of means for nitrogen and compost columns:	
in same half of table	±49 (140)
in different halves	±54 (168)

Main effects:	*N*	P_2	*D*
	+65	+274	+581
S.E. (L.S.D. 5%)	±74 (N.S.)	± 60 (122)	± 50 (100)

TABLE 3.

NPD EXPERIMENT.

Ukiriguru—Hill Sand—Trial (26).

5 replications of 2 × 2 factorial, with split plots of 1/69·7 acres giving 4 nitrogen treatments. Compost and phosphate applied in 1952 and 1955. Sulphate of ammonia applied at flowering in February 1955, February 1956, early March 1957, and February 1958.

5 foot ridges, 2 rows of 18″ spacing, 2 plants per hole. Cotton planted 9th December 1957.

p_0, p_1 0, 150 lb. double superphosphate/acre.
d_0, d_1 0, 6 tons compost/acre.
n_0, n_1, n_2, n_3, 0, 50, 100, 200 lb. sulphate of ammonia/acre.

Mean yields: seed cotton lb./acre.

Nitrogen treatments (applied each season)	*Third indicator crops from dressings of compost and phosphate*				
	(*i*)	*d*	*p*	*pd*	*Mean*
No nitrogen	568	1094	851	1168	920
50 lb./acre	821	1151	1106	1253	1083
100 lb./acre	848	1241	1108	1385	1145
200 lb./acre	885	1240	1095	1566	1196
Mean	780	1181	1040	1343	

S.E. (L.S.D. 5%) in same column	±70 (200)
S.E. (L.S.D. 5%) in different columns	±80 (246)
S.E. (L.S.D. 5%) of means for nitrogen	±35 (100)
S.E. (L.S.D. 5%) of means for phosphate and compost columns	±52 (160)

Main effects:

P	+210	S.E. (L.S.D. 5%)	±37 (113)
D	+352		
N_2	+225	S.E. (L.S.D. 5%)	±35 (100)

TABLE 4.

NPS EXPERIMENT.

Ukiriguru—Hill Sand—Trial (44).

Started (1957-58) phosphate and gypsum applied 22nd November 1957, urea and sulphate of ammonia applied 24th February 1957, 2 × 2 × 3 factorial partially confounded, testing all combinations of:—

n_0, n_1, n_2, 0, 200 lb./acre sulphate of ammonia, 90 lb./acre urea.
p_0, p_1, 0, 100 lb./acre double superphosphate.
s_0, s_1, 0, 280 lb./acre gypsum.

6 replications in 12 blocks of 6 plots, each 1/69·7 acre. Cotton planted 7th December 1957.

First indicator crops.

Mean yields: seed cotton lb./acre.

	(*i*)	*p*	*s*	*ps*	*Mean*
(i)	1219	1441	1265	1069	1248
n_1	1729	1736	1587	1707	1689
n_2	1559	1644	1508	1813	1631
Mean	1502	1607	1453	1529	

S.E. (L.S.D. 5%) of means for nitrogen	±38 (107)
S.E. (L.S.D. 5%) of means for phosphate and sulphur columns	±43 (123)

Main effects:	N_1	N_2	S	P
	+441	+382	−63	+90
S.E. (L.S.D. 5%)	± 37 (107)	± 37 (107)	±31 (N.S.)	±31 (88)

Manuring and Fertilizers.

The difference in the style of responses obtained from the manurial and fertilizer trials compared with those of the last two seasons lies in the absence of NP interactions. More soil science work on these experiments is needed.

Trial (8) carried its 14th indicator crop since the original applications were made. The plots that had had 1½ tons of cotton seed ash applied in 1944-45 still showed a 200 lb. seed cotton per acre increase over the control, which rose to a 450 lb. seed cotton per acre increase when nitrogen was top dressed to a section of the plots. This yield increase was the same as that where 7 tons per acre FYM had been re-applied in 1955-56—now a second residual response.

In Trials (9) and (26), which have been cultivated as NPD trials now for a considerable number of years, the top NPD treatments resulted in increases of around 1,000 lb. seed cotton per acre over the controls.

The Exhaustion Plot, referred to in previous reports, yielded at the rate of about 400 lb. seed cotton per acre. The adjacent "High Field" Plot, mentioned in last year's report, again manured with 3 tons per acre cattle manure, and top dressed with 100 lb. per acre sulphate of ammonia, yielded 2,300 lb. seed cotton per acre.

Soil Science.

BY

A. M. KABAARA and P. H. LE MARE.

Effect of Organic Manure on Nutrient Status.

Soil samples were taken from all combinations of the absence and presence of compost, triple superphosphate and ammonium sulphate in one replicate of Trial (26). The samples were taken in November 1956. Applications of compost (6 tons per acre) and triple superphosphate (75 lb. per acre) had been made in November 1952 and 1955. Sulphate of ammonia (200 lb. per acre) had been applied as a top dressing annually since March 1953, so that at the time of sampling four such applications had been made.

The analytical data presented in Table 5 are for the effect of compost, averaged over the other treatments, on soil phosphorus extracted by 0·002 N sulphuric acid (the Truog method), on total exchangeable bases, and on exchangeable calcium and potassium.

TABLE 5.

THE EFFECT OF COMPOST ON TRUOG PHOSPHATE AND EXCHANGEABLE BASES IN HILL SANDS, UKIRIGURU.

Sample depth	*Truog P mg P/100g. soil*		*T.E.B. me/100g. soil*		*Exch. Ca me/100g. soil*		*Exch. K me/100g. soil*	
	Compost		*Compost*		*Compost*		*Compost*	
	abs.	*pres.*	*abs.*	*pres.*	*abs.*	*pres.*	*abs.*	*pres.*
0- 6″	·39	·92	2·13	2·84	1·32	1·80	·25	·42
6-12″	·35	·54	2·28	2·28	1·57	1·46	·26	·30
24-30″	·33	·36	2·03	2·32	1·24	1·43	·22	·20
42-48″	·29	·19	2·32	2·39	1·22	1·56	·18	·19
60-66″	·45	·27	2·18	2·48	1·17	1·50	·20	·22

Compost has increased the amount of Truog phosphate in the top 12 inches of soil. At 24 to 30 inches there is no effect of compost on Truog phosphate, but below 42 inches the plots without compost have higher P values than those which have received compost.

Compost has increased the exchangeable bases in the soil; the calcium values are greater on compost plots at all depths, except 6-12 inches, down to 60 inches, whilst potassium values have been increased by compost only in the surface soil.

The Effect of Sulphate of Ammonia on Exchangeable Bases and pH.

The above-mentioned soil samples taken from Trial (26) have been used to determine the effect of sulphate of ammonia on the exchangeable bases and pH. The data are given in Table 6.

TABLE 6.

THE EFFECT OF SULPHATE OF AMMONIA ON TOTAL EXCHANGEABLE BASES AND pH IN HILL SANDS, UKIRIGURU.

Sample depth	*T.E.B. me/100g. soil*		*pH soil: water = 1: 2·5*	
	Sulphate of ammonia		*Sulphate of ammonia*	
	absent	*present*	*absent*	*present*
0- 6″	3·01	1·96	6·42	5·44
6-12″	2·39	2·17	6·33	5·40
24-30″	2·15	2·18	5·90	5·61
42-48″	2·28	2·43	5·90	5·65
60-66″	2·16	2·50	5·82	5·52

Sulphate of ammonia, applied at 200 lb. per acre per annum for four years before sampling, has caused a reduction in the total exchangeable bases in the top 12 inches.

At 24 inches there is no effect of sulphate of ammonia, but below 42 inches values for exchangeable bases are higher on plots which have received sulphate of ammonia. The effect of this fertilizer on soil pH has been to lower the values at all depths: at the surface the decrease is one pH unit, but at 24 inches and below the reduction is about 0·3 pH unit.

It is evident that sulphate of ammonia has a marked effect on the base status of the hill sands at Ukiriguru, but it appears that some of the bases lost from the surface soil by leaching are accumulated in the sub-soil.

In Trial (44) the effect of a single application of sulphate of ammonia was to lower the pH in the surface soil (0-6 inches) from 6·48 to 5·66. In the same trial urea, supplying equivalent nitrogen, lowered the pH to 6·20.

Soil Nitrate.

The study commenced in the 1956-57 season on the amount and movement of soil nitrate under cotton was continued in 1957-58 but on only four treatments: no manure or fertilizer, sulphate of ammonia, triple superphosphate and both these fertilizers. The same replicate in Trial (26) that was sampled in 1956-57 was used again.

Sampling was started on 21st January. At that time there was about 2 ppm NO_3-N in all plots at all depths down to 60 inches. On plots which did not receive nitrogen fertilizer the NO_3-N value fell during April to less than 0·5 ppm N in the top 12 inches, and to about 1 ppm at depths greater than 12 inches. On these plots the NO_3-N values rose again to 2 ppm in May and remained steady until the end of June when sampling ceased.

On plots which had received sulphate of ammonia, applied in early March, there was a rise in NO_3-N in the top 12 inches of soil about one month later. However, unlike the previous year, when leached nitrate was found to 60 inches, there was no increase in NO_3-N below 12 inches.

The amounts of nitrate in the soil below 24 inches tended to be lower on plots which had received phosphate. This observation has been made in previous seasons and is presumably due to the greater uptake of nitrate by the larger plants growing on the phosphated plots.

Analysis of Organic Manures.

Analytical data are given in Table 7 for six organic manures: two samples of compost made at Ukiriguru and four samples of cattle manure taken from near-by African bomas (kraals).

At Ukiriguru compost is made in open bomas situated at various places on the farm. Maize and sorghum stalks, cotton stalks and other trash are carted in. Cattle are herded into the bomas at night and dung is thereby added. The material is left in the boma for about fifteen months and is turned two or three times during that time.

The manures from African kraals vary considerably from sample to sample as they accumulate under different conditions. No bedding was found in the bomas which were sampled. The manure may

accumulate over a considerable length of time: at Ngudama, for example, there was a depth of up to 2½ feet to the bottom of the heap. Cattle would have been kraaled there for two years or more. The analytical data are presented in Table 7.

Table 7.

Analytical data for composts and manures.

Origin	*Moisture % of wet material*	*Per cent. of air dry material*				
		Loss on ignition	*Acid insoluble residue*	*N*	*P*	*K*
Ukiriguru composts						
Machafu (M1)	23·4	17·2	77·1	0·58	0·16	0·83
Machafu (M2)	25·2	21·7	69·2	0·74	0·23	1·03
African boma manures						
Nyamule (M3)	—	25·6	68·3	0·64	0·31	1·62
Nyambiti (M4)	—	24·1	62·8	0·68	0·25	1·46
Ngudama (M5)	—	36·4	48·2	0·85	0·42	2·22
Nyashimba (M6)	—	29·0	61·2	0·53	0·32	1·31

An important feature of the data is the evidence of the low organic content of the manures, as determined by loss on ignition, and of the large amount of acid insoluble inorganic material remaining after ashing, most of which is silica.

At Ukiriguru the usual application of compost is 6 tons per acre. The analyses presented above indicate that this would supply about 70 lb. N, 20 lb. P and 90 lb. K per acre.

Soil Moisture.

Observations on soil moisture on ridged land have been continued, using nylon/stainless steel resistance units covered with plaster of paris. Units were placed in several sites under the ridge crest and under the furrow bottom. The ridge crests were five feet apart, the standard distance at Ukiriguru, and all ridges were tied.

Below the ridge crest the units have shown that water may be removed by plants down to at least 60 inches, the greatest depth at which units were placed.

Last year it was reported that there was little removal of water below the furrow, only the 6-inch unit showing appreciable change. However, in 1958 water was removed from a depth of three feet below the furrow surface. No root excavations were made in 1957, but in 1958 root ramification was found to be extensive, with laterals reaching the adjacent ridge. It appears that the pattern of water uptake, and possibly of root development, may vary considerably between seasons. Further root and soil moisture studies are planned and will be related to studies of nutrient status in the soil and its uptake by the plant.

Cotton Breeding.

BY

J. E. PEAT and K. J. BROWN.

As has been mentioned in previous reports there are three cotton breeding programmes on Ukiriguru; the main two are now approaching the comparative testing stage. One is the testing of straight Ukiriguru selections, now almost entirely ex daughter strains of 8/290-0/334 and 1/667. It had been expected, with the sorting out of Albar 51 hybrid material, that these straight Ukiriguru strains would have been superseded, or would be about to be superseded — but the work described in the bacterial blight section shows that in selecting for yield and discarding for scruffiness a somewhat higher degree of resistance to *Xanthomonas malvacearum* has been achieved than was anticipated. The best of the later strains from this original programme have suitable lengths of maturity, a considerable degree of jassid resistance, and desirable lint qualities, and therefore remain possibilities for later multiline issues. They appear now in trials with the Albar 51 hybrid strains which have to be sorted further for qualities, additional to yield and bacterial blight resistance.

A start has been made this season utilizing the classifying advice of the Tanganyika Lint and Seed Marketing Board in trying to get an early assessment of the comparative lint values of the Ukiriguru strains. This advice is very much welcomed and will become increasingly important.

As has been mentioned, some of the possible strains for Uk58 were multiplied in agronomic trials, where the different treatments, covering a range of soil fertility, gave considerable differences in plant growth and, therefore, yield. Other multiplications were on uniform good land. The lint from the agronomic trials received on the whole poor lint reports compared with the uniform good land multiplications, with comments on short and mixed staple. This illustrates the difficulties there are in getting reasonably even-running lint lots in areas of uneven fertility, and with African peasant cultivation.

A Uk58 seed issue has been constituted for 1958 first issue (consisting of strains segregating from 0/334 and 1/667) for multiplication in the Lyoma area near Bukumbi Ginnery (Mwanza District)—an area about 7 miles from Ukiriguru. The Uk55 seed which had been bulked in that area this past season has been transferred to Ushashi zone in the Musoma District.

The improvements achieved stage by stage in the original breeding programme, and thus the profits to the industry resulting from the successive seed issues, are satisfactory; they show that the expense of repeated seed issues has been fully justified. The results obtained are

LINT PER ACRE INCREMENT OF UKIRIGURU SEED ISSUES
OVER MWANZA 561 FROM VARIETY TRIALS 1947-48 TO 1957-58

FIG. 1.

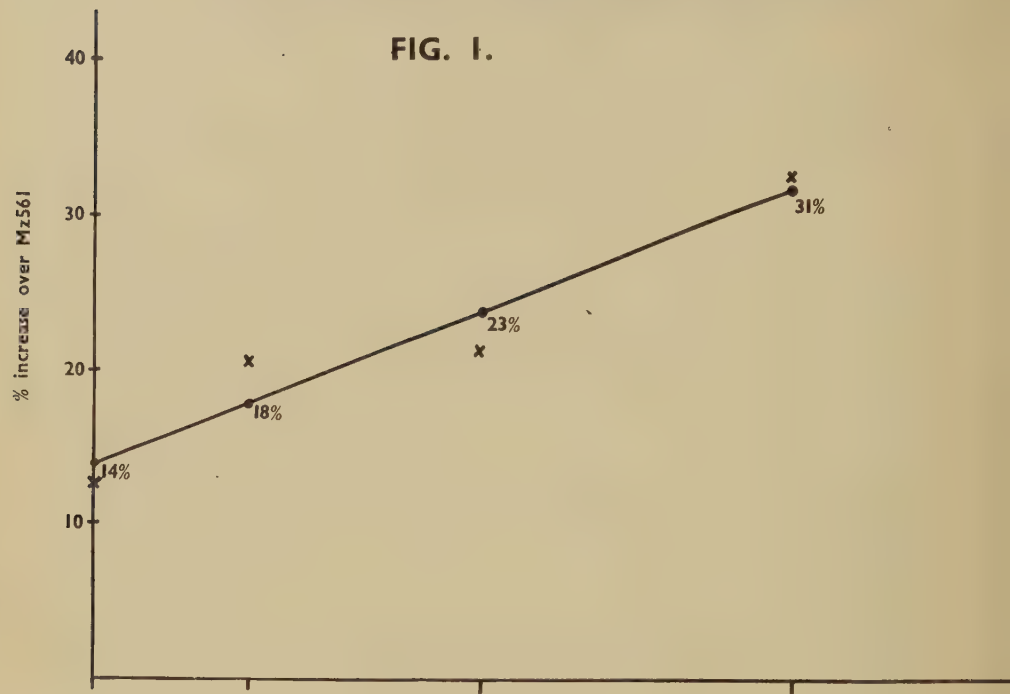
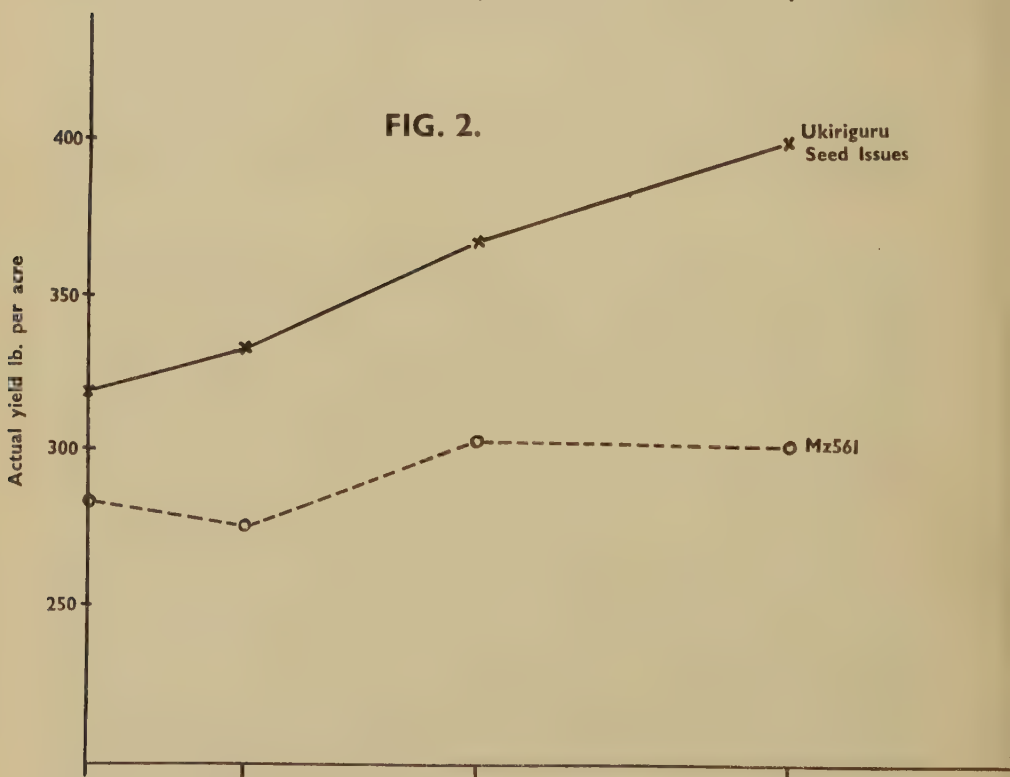


FIG. 2.



	Uk46	Uk48	Uk51	Uk55
Seasons	10	9	7	4
Trials	116	97	82	50

(*Seed cotton*

Strain	Ukiriguru		Lubaga	Kwimba		Shinyanga		M	
	Poor land variety trial	Main variety trial		*Mwananga*	*Buruguta*	*Lagana*	*Butulwa*	*Lalago*	*Lu*
Mz561	718	1369	715	791	505	885	697	778	1
Uk51	809	1450	768	987	602	918	648	816	1
Uk55	886	1514	818	1055	675	877	692	825	1
(Mean of two)									
5/93	933	1558	766	1119	759	811	746	885	1
5/106	906	1626	796	1117	644	865	796	900	1
5/146	889	1586	788	1139	710	943	660	818	1
E21/15/503		1403	764	929	669	952	787	742	1
E21/15/504		1484	838		635		838	878	1
G21/15/528				905		827			
G51/15/276		1509	757		838		729	782	1
G51/15/288				1023		998			
M14/15/397				1201		872			
M14/15/416		1504	848		835		713	773	1
S.E.		64·6	37·2	47·6	57·6	57·6	53·7	40	
L.S.D. (P=·05)		185	104	136	165	N.S.	N.S.	N.S.	
Coefficient of variation		12	12	12	21	16	18	12	

Albar hybrid strain tr

Distribution of L

	20-24·9	25-29·9	30-34·9	35-39·9	40-44·9	45-49·9	50-54·9	55-59·9	60-64·9	65-69·9
A.7×7 balanced lattice (4 controls)								1		1
B.7×7 ,, ,, (4 ,,)										2
C.5×5 ,, ,, (2 ,,)										1
D.5×5 ,, ,, (2 ,,)										1
E.5×5 ,, ,, (2 ,,)								1	1	
F.4×4 ,, ,, (2 ,,)										
G.7×7 balanced lattice square* (4 controls)	1	1		1	2	1	1			
H.7×7 balanced lattice square* (4 controls)										1
*Replicated progeny rows.										

Details of trials.	A	B	C	D
Planting dates	10.12.27	11.12.57	5.12.57	5.12.57
Plot sizes	5′×30′	5′×30′	5′×30′	5′×30′

Spacing (all trials) 2 rows per 5′ ridge at 18″, thinned to 2 plants per hole.

TABLE 8.

TRAIN TRIALS.

ields in lb. per acre)

DISTRICT PLOTS								MEAN Uk51 lint/lb./acre	MEAN Lint lb. per acre	MEAN Lint as % Uk51
SWA		GEITA		NASSA	MUSOMA	UKEREWE				
uru	*Somanda*	*Arugongo*	*Ibondo*	*Shigala*	*Suguti*	*Lagata*	*Buhima*			
19	1322	1360	646	765	880	1778	924	349	317	91
24	1533	1411	698	924	907	1801	966		349	100
29	1751	1488	830	850	827	2104	978		379	109
57	1830	1562	871	974	1009	2213	1033		406	116
31	1863	1504	753	944	890	2264	958		400	115
22	1760	1544	785	876	863	2300	956		391	112
48	1761	1502	775	1073	1125	2004	1216	354	414	117
60			831			2193		346	393	114
	1453	1431		909	967		1063	318	319	100
35			780			2108		346	380	110
	1725	1475		1142	1041		1134	364	418	115
	1678	1515		868			1136	373	394	106
61			720			2099		346	379	110
72·3	74·6	62·6	35·6	65·9	50·7	107·2	45·0			
04	210	N.S.	100	186	143	302	129			
13	11	11	12	16	14	13	11			

TABLE 9.

ALS AND REPLICATED PROGENY ROWS.

nt Yields—% Control (Uk55)

75-79·9	80-84·9	85-89·9	90-94·9	95-99·9	100-104·9	105-109·9	110-114·9	115-119·9	120-124·9	125-129·9	130-134·9	Hybrids outyielding controls—significant at P=·05	Mean yield of controls lint-lb/acre	Coefficient of variation %
4	8	3	5	14	4	4						0	477	12·5
	1	8	14	13	4	3						1	471	11·3
3	3	2	7	2	2	1						0	220	14·3
3	4	4	7	2	2							0	235	11·9
1	5	4	3	1	3							0	247	11·1
2	2	6	3			1						1	607	8·6
2	2	5	7	7	7	4	2	1				0	609	18·3
5	11	2	6	4	1	3	5	1	1		2	2	500	22·0

E	F	G	H
12.57 ×30′	16.12.57 5′×30′	12.12.57 5′×7′ 6″	12.12.57 5′×7′ 6″

illustrated in Figures 1 and 2, as measured over a range of years, in small plot trials, on Ukiriguru, Lubaga, and the scatter of district plots. In Figure 2 the relative yields of Mz561 to each Ukiriguru issue were calculated from trials in which that particular issue appeared. The results from the newer material this last season are illustrated in Tables 8 and 9.

The view of the first writer—without committing his colleagues—is that the actual increases in crop, as a result of the various seed issues, very probably are greater than shown by the results from the small plot statistical trials. (This would make an interesting follow-up with larger comparisons under African growing conditions.) Some of the factors that would have influenced yield differences on bulk growing compared with small plot comparisons would be the movement and development of jassid attack, especially on poorer soils, and the spread of the two phases of *Xanthomonas malvacearum,* blackarm and bacterial boll rot. On the whole, Ukiriguru strain trials, on the station and on district plots, are reasonably well farmed, with reasonable times of planting. The level of yields is better than the average African yield. As rather a loose generalisation it might be said that cotton strain differences in the Lake Province show up as greater where growing conditions are hard, rather than the reverse.

Diseases.

BY

M. H. ARNOLD and K. M. ARNOLD.

Breeding for Resistance to Bacterial Blight (*Xanthomonas malvacearum*).

The Albar 51 hybrids have been handled in two main sections. The section tested in small bulks trials last season comprised mainly derivatives of 2nd and 3rd backcrosses. This season, re-selections from 1st backcrosses and derivatives of 4th backcrosses were tested in small bulks trials on the station (Trials A-F) whilst the best of the 2nd and 3rd backcross derivatives were tested in district plots and re-selections from some of them in replicated progeny rows (Trials G and H). Yields are shown in Tables 8 and 9.

The performance of the strains in district plots showed that a yield level comparable with that of Uk55 has in many cases been achieved over a range of conditions.

The relationship between earliness and yield was again studied over the range of material. This season most of the later strains fell into the higher yielding classes but the relationship was by no means clear-cut and a proportion of the earlier strains was also amongst the higher yielders.

An important factor in the growing season was the drought in February and an associated build-up of aphids. There was noticeable segregation amongst the Albar hybrids in their ability to withstand and recover from these conditions. The seven lowest yielding progenies in Trial G (Table 9) appeared to suffer particularly in this respect. All were selections from a strain which had yielded well in the previous season when the growing conditions were less severe.

TABLE 10.

REACTION OF STRAINS TO NEEDLE-PRICK INOCULATION WITH *Xanthomonas malvacearum*.

Strain	*Stem resistance. Mean grade (Scale 0-6)*	*Boll resistance. (Mean maximum lesion diameter in mm.)**
Local	2·83	5·95
Uk46	2·76	5·95
Uk51	2·13	5·45
Uk55	1·35	4·23
E21/15/504	0·89	1·46
Albar 49	0·51	0·77
S.E.	±0·16	±0·25
L.S.D. (P=·05)	0·45	0·71
Coeff. of variation	13·6%	10·6%

Average number scored per strain (a) stems 156
(b) bolls 609

With the demonstration of a degree of both stem and boll resistance in Uk55 (see Table 10) it has been necessary to increase the working standards of resistance in the Albar hybrid material. Some of the hybrids, intended as a first wave of increased resistance, show little or no advancement over Uk55 and in the absence of some other desirable character, such as enhanced lint quality, have been discarded. Amongst the others, the most promising strains, bearing in mind the combination of all desirable characters, are derivatives of 3rd backcrosses and in some of these, such as E21/15/504 (Table 10), a high standard of resistance has been retained. Derivatives of first backcrosses, whilst showing a high degree of resistance and in many cases high yield, tend to be coarse-linted or to show proneness to seed coat damage. A few derivatives of 2nd backcrosses are still being continued but all need improvement in one character or another.

The programme involving the addition of the gene B_{cm} to Ukiriguru strains continued, 5th backcrosses being made in-season and 6th backcrosses out-of-season. It is doubtful, in view of the failure of B_{cm} to confer a high degree of boll resistance, if this material will have any advantages over the other resistant stocks now being tested. A range of selections from this programme is being put into the breeding pool in the coming season to be handled side by side with other stocks.

*Each boll was inoculated in the centre of each locule. When scoring, only the lesion of maximum diameter on each boll was scored.

Inoculation techniques.—In the earlier generations seed inoculation was employed as a means of inducing bacterial blight on susceptible seedlings. These could then be rogued out at an early stage and so reduce the numbers of plants to be stem-inoculated. As the proportion of susceptibles in the material decreased, seed inoculation became less effective and was discontinued after the 1955-56 season.

With the increasing importance of resistance to bacterial boll rot, seed inoculation was again tried this season on twenty strains, ranging from fully susceptible to near-immune, as a means of providing inoculum potential for a later build-up of leaf and boll attack.

In order to encourage such a build-up, two replicates were grown under a sprinkler irrigation system which was used in an attempt to create conditions favourable for infection. By this means an increase in intensity of infection of 40% over the non-irrigated plots was achieved as measured by grading the plants for overall leaf infection on a scale of 0-3. This grading gave clear distinctions between highly resistant and highly susceptible strains but was of doubtful value in discriminating between strains in the middle range. With refinements, the technique could probably be developed to give accurate comparisons of the relative resistance of strains under conditions simulating a natural epidemic, but the ratio of work involved to information gained is considered too great for the method to be adopted as a practical aid to plant breeding. Bolls were not scored in this trial as by this time sufficient experience had been gained with the needle-prick technique* for this to be preferred as a means of assessing resistance to boll rot. It has the great advantage to the plant breeder of giving reliable information on the single plant, and in future all plants in the breeding stocks, in addition to being stem inoculated, will be boll inoculated as a matter of routine.

The system of grading for stem resistance has been modified in order to achieve a finer distinction between the more resistant strains. A further grade has been introduced so that the new scale runs from 0 to 6 compared with the scale previously used of 0-5.

Resistance in strains of local origin.—Boll inoculation of strains derived from Mwanza Local showed that boll resistance followed the trends reported last season for stem resistance, namely that successive seed issues, represented by Uk46, Uk51 and Uk55, show enhanced resistance to bacterial boll rot (see Table 10). Further work on this material is designed to investigate the extent to which stem resistance can be advanced by re-selection in 8/290 stocks, how this resistance compares with that in other known resistant stocks and to what extent stem resistance and boll resistance are associated.

*Logan, C. (1958). "Bacterial Boll Rot of Cotton, I." Annals of Applied Biology, 46, 230-242.

Other Work on Bacterial Blight.

Seed treatment.—Attention was given this season to the possibilities of improving the efficiency of seed treatment under commercial conditions. As a result of last season's tests and of further tests carried out using a Booth drum, recommendations were made that the rate of Perecot application be increased from 1 : 250 w/w to 1 : 200 w/w and that the charging rate for the 35 cu. ft. drum be reduced from 10 cwt. to 8 cwt. in order to achieve a more uniform coverage of seed. Both these recommendations were put into effect.

In addition, experiments were carried out on the use of mercurial formulations under commercial conditions. These led to the testing on a larger scale of Abavit 'B', some fifty tons of Uk55 being treated with this compound. In the coming season it will be possible to make some assessment of the control of bacterial blight achieved, by studying the disease in the Uk55 multiplication area.

Trash infection.—In a trial in which cotton trash was applied to plots at the end of the previous season and allowed to weather under wire netting throughout the dry season, no infection, attributable to the presence of the trash, could be detected in cotton grown this season. Furthermore, no infection could be detected from trash which had been stored in bags over the dry season and applied immediately before cultivation. In this experiment, normal cultivation practices were observed, the weeds and trash being scraped into the furrows and the new ridges built over them.

When trash was applied on the tops of the new ridges and covered to a depth of about 1 inch with soil, germination was reduced and in the case of stored trash about two-thirds of the seedlings showed cotyledon infection whilst no infection was recorded where trash which had been weathered under wire netting was applied (see Table 11).

TABLE 11.

INFECTION FROM TRASH.

Results from observation plots planted with acid treated Uk51.

Treatment	*No. of plots*	*Total seedlings*	*No. infected (cotyledons)*	*% infected*
No trash	6	133	1	<1
Stored trash	2	35	22	63
Weathered trash	4	70	0	0

These latter results are consistent with those described by Parker* as occurring in Northern Nigeria.

It seems possible that under Lake Province conditions, the normal practice on the hill sands of building 5 ft. ridges over the previous

*Parker, H. M. (1957). "Survival of Bacterial Blight of Cotton in Crop Debris." Paper presented at the West African Cotton Research Conference, Samaru, Northern Nigeria.

year's furrows into which the weeds and debris are scraped, may be a factor in controlling trash infection. These indications will be followed up in the coming season and, in addition, studies have been started on the survival of *Xanthomonas* in trash exposed to the weather.

Wilt (*Fusarium oxysporum f. vasinfectum*).

This year's survey revealed several more infested localities in coastal areas of Geita District but it is doubtful to what extent this represents spread of the disease, since some of the discoveries were in areas which had not been searched previously. No outbreaks have been confirmed in inland areas and the disease seems to be associated with soil types occurring round the Lake fringe. Viewed against the crop as a whole it remains economically of little importance.

As an insurance against the possibility of wilt becoming more widespread, a start was made on testing resistant varieties of cotton. Four American varieties and one from the Belgian Congo were compared with Uk51 on three infested sites. Results for the three sites were similar, and showed that up to mid April all the exotic varieties were highly resistant, relative to Uk51. From this time onwards, however, in spite of periodic dusting with a DDT/BHC powder, the exotic strains began to suffer severely from jassid attack and an increasing number showed symptoms of wilt. It was reported that in early July nearly all the plants showed vascular staining. It may be that with the severe damage to the plants caused by jassid, the resistance broke down. If a programme of breeding for resistance is to be attempted these strains would be of very doubtful value as resistant parents.

In the coming season an extensive search will be made for resistance in strains adapted to the local environment. The fact that a few healthy plants persisted until the end of the season in the Uk51 plots on the infested sites suggests that there is some possibility of selecting out resistant lines from local stocks. This inference was borne out by the results from another infested site where Uk51 was compared with three Uganda strains at the request of Wickens. The indications from this site were that Uk51 showed some resistance relative to S47 whilst C(50)20 and DE715/6M showed high resistance.

Wilt infested areas were visited during the growing season by Wickens, who has started work on certain aspects of the disease at Namulonge. During his visit further root and soil samples were collected, from which Whitehead of E.A.A.F.R.O. was able to confirm the presence of the root-knot nematode (*Meloidogyne* sp.) in association with other nematode species in samples from both Kome Island and from Arugongo on the coast of Geita District. The absence of significant populations of nematodes in the Arugongo area visited by Whitehead last season may have been due to partial flooding and a

high water table which could have reduced the nematode populations to an insignificant level.

In the coming season the work will be handled by Perry and the programme expanded in an attempt to discover what factors, if any, are limiting the spread of the disease.

Cotton Pests.

BY

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(*Included by courtesy of the Director of Agriculture, Tanganyika Territory.*)

In the 1957-58 season insect attack on cotton was widespread and a fair amount of damage was done. In general, however, the damage could not be classed as severe, as shown by the final yield.

Heliothis armigera (*American bollworm*).—The attack on cotton was extensive throughout the Lake Province, but the loss of yield caused was small, as the attack was mainly restricted to March and April and the numbers of bollworm larvae present were never very high, allowing the plant to compensate for much of the loss. The earliest generation on cotton at Ukiriguru appeared in late February and spraying was necessary on one variety trial. There was then a lull and a heavy population appeared on the mbuga in April and May. The attack on the mbuga probably came from adjacent early planted sorghum which was carrying a small population early in the season.

From February to April *Heliothis* larvae were found on most crops, but from April to June they were collected from cotton only. The last larvae were collected in the field in early July and a single adult was taken in a light trap in August. It is considered that diapause during the dry season plays a very important part in the life cycle of *Heliothis* in the Lake Province and it is hoped that a quantitative study of this will be possible in 1959.

Earias sp. (*Spiny bollworm*).—Present throughout the Province. Spiny bollworm was present very early in the season at Ukiriguru and was present throughout the growing season in most areas, although in very small numbers. In May, however, there was a considerable increase in numbers, especially in Geita District, and in July it was found to be the most important pest in late grown cotton in Missenye. This pest is small and inconspicuous in habit, often living completely inside the bolls and, the main attack coming late in the season, it was responsible for much more damage than was generally realised. Numbers are in general small, in comparison with *Heliothis,* and there seems to be little hope of any economic chemical control measures.

Effective control, however, might be achieved by organised uprooting of the known malvaceous wild hosts.

Helopeltis.—Very few specimens were found and very little damage was done, even in areas where a fairly heavy *Helopeltis* attack is to be expected.

Calidea dregii.—This pentatomid becomes important in cotton areas near 'Miombo' woodland (*Brachystegia* complex). It is found in small numbers in several areas, but is most important in Biharamulo and Geita.

Aphis sp.—Aphids were present in large numbers during a dry spell in January and February but were adequately controlled by the onset of heavy rain. The dry spell did not last long enough, about three weeks, to allow much permanent damage to be done.

Jassid.—Present in all areas. A fairly heavy attack developed at Lubaga but had little effect on final yield.

Stainers.—Stainers were present in all areas, the more important species being *D. fasciatus, D. nigrofasciatus* and *D. superstitiosus. D. cardinalis* was also present but was of lesser importance. In most areas stainer attack does not build up until late in the season, after normal spraying has been completed, but in North Mara and Shinyanga stainers were present in considerable numbers in March and April and routine spraying had a substantial effect on the population and on the final yield of cotton.

There is a considerable difference in the emphasis of stainer attack throughout the Province, both in time of attack and species concerned, and this problem should be investigated.

Insecticide Trials.

Spraying trials were carried out by the extension division, Department of Agriculture, in most of the cotton growing areas. In general the trials did not show a highly economic return, partly because insect attack was not severe and partly because spraying, mainly carried out during March and April during the *Heliothis* attack, was too early. This allowed re-invasion of the plots by stainers and spiny bollworm late in the season, which tended to mask the results of the spraying, which, while it was going on, usually looked successful. If trials are to be carried on in the 1958-59 season it is intended that more allowance will be made for the plant's ability to compensate for early insect attack.

An insecticide trial was laid down at Ukiriguru to test the effectiveness of a new insecticide, using applications of 1 lb. DDT + $\frac{1}{4}$ lb. BHC per acre as a standard. The new insecticide, Didigam A, was equally effective but cost more than the standard treatment. A heavy *Heliothis* attack developed on the trial area and highly economic

returns were obtained. In the standard treatment the cost of insecticide was covered plus a profit of Shs. 98/60 per acre. Until the price of insecticide drops considerably, however, there is, I feel, very little chance of insecticide use being adopted by the African growers in Lake Province. Returns are small and results are not spectacular and easily visible.

Appendix.

Origin and Special Characteristics of the Main Cotton Strains Mentioned.

Mz561	A straight selection from Mwanza Local, first multiplied in the 1939-40 season.
Uk51	A multiline seed issue incorporating strains with jassid resistance, first multiplied in the 1951-52 season.
Uk55	A multiline seed issue composed of 0/334 and 1/667, strains outstanding for yield and jassid resistance. First multiplied in the 1955-56 season.
Uk58	A multiline seed issue of selections from 0/334 and 1/667. To be multiplied in the 1958-59 season.
0/334	Ex 8/290
1/667	Ex 8/290
5/93	Ex 0/334
5/106	Ex 1/667
5/146	Ex 1/667
5/266	Ex 0/328, ex 8/290
67/04/42	Ex Albar × (Mwanza Local selections)^2
G51/15/276	Ex Albar × (Mwanza Local selections)^3
G51/15/288	Ex Albar × (Mwanza Local selections)^3
G21/15/528	Ex Albar × (Mwanza Local selections)^4
E21/15/503	Ex Albar × (Mwanza Local selections)^4
E21/15/504	Ex Albar × (Mwanza Local selections)^4
M12/15/385	Ex Albar × (Mwanza Local selections)^4
M14/15/397	Ex Albar × (Mwanza Local selections)^4
M14/15/416	Ex Albar × (Mwanza Local selections)^4
Albar	Nigerian Allen (Al) blackarm resistance (bar) selections made at Namulonge. Two series of selections were made independently, Albar 49 in 1949 and Albar 51 in 1951.
C(50)20	Ex Uganda BP52
S47	Ex Uganda BP50
DE715/6M	Ex Uganda BP50 × B181

Received February 1959.

T. BUNCLE AND CO. LTD., ARBROATH

PROGRESS REPORTS FROM EXPERIMENT STATIONS

The reports for the seasons up to and including 1950-51 were published in seasonal volumes; the following are still in print and available at 3/- per volume post free.

1923-25 (one volume), 1926-1927, 1931-32, 1934-35, 1935-36, 1942-43 and 1945-46 to 1950-51.

From 1951-52 the reports from each territory were published individually each season. A few of the 1951-52 reports are out of print, but all others are available post free at 1/- per report or 7/6d. for the seasonal set.